Airway Management in the Trauma Patient

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Objectives

1. Technical Considerations
2. Therapeutic Goal of Airway Management
3. Clinical and Physiological Considerations
Therapeutic Goal of Airway Management

Adequate spontaneous breathing
  Provide oxygen supplementation

Proceed to manual assisted ventilation
  Apneic patient
  Inadequate spontaneous tidal volumes
  Excessive work of breathing
  Hypoxemia with poor spontaneous ventilation
<table>
<thead>
<tr>
<th>1°</th>
<th>2°</th>
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<tr>
<td><strong>1°</strong></td>
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**TWO-PERSON MASK VENTILATION**

<table>
<thead>
<tr>
<th>2° Person Does Jaw Thrust</th>
<th>2° Squeezes Reservoir Bag</th>
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<tbody>
<tr>
<td>3 Hand Jaw Thrust/Mask Seal</td>
<td>2 Hand Jaw Thrust/ Mask Seal</td>
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1° Person: 
- Assists by holding the head in an upright position.

2° Person: 
- Performs jaw thrust and mask seal.
- Squeezes the reservoir bag.

*Note: The diagrams illustrate the positions and actions of the two persons during the ventilation process.*
Therapeutic Goal of Airway Management

Augment airway protection ("secure" airway)

Augment oxygenation

Augment ventilation

Control PaO2 & PaCO2 within prescribed guidelines (certain injury types)

Prophylactic airway management (risk reduction)
Indications for Endotracheal Intubation

- Airway protection
- Relief of obstruction
- Need for mechanical ventilation / O₂ therapy
- Respiratory failure
- Shock
- Need for hyperventilation
- Reduce the work of breathing
- Facilitate suctioning / pulmonary toilet
Preparation for Intubation

Assess degree of difficulty for intubation
Assure optimal ventilation and oxygenation
Consider gastric decompression
Analgesia, sedation, amnesia, neuromuscular blockade as needed
Degree of Difficulty Assessment

- Neck mobility
- External face
- Mouth
- Tongue and pharynx
- Jaw

- Consider options for obtaining an airway that maintain ventilation

- Obtain expert assistance
Degree of Difficulty Assessment

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- Consider options for obtaining an airway that maintain ventilation

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Difficult Airway

Difficult Airway Recognized

- Spontaneous ventilation
  - Preparation
  - Call for assistance

  Expert consultation
  - Flexible fiberoptic technique
  - Awake intubation
    - Direct laryngoscopy
    - Blind nasal intubation (if spontaneous respirations)

  LMA
  - Succeed
  - Fail

  Expert consultation
  - Surgical airway

Unrecognized Difficult Airway or Emergent Airway

- Combative patient
- Uncooperative patient

  ± Sedation
  ± Neuromuscular blocker (with caution)

  Manual mask ventilation possible

  No
  - LMA
  - ETC
  - Needle cricothyrotomy
  - Call for assistance

  Yes
  - Direct laryngoscopy
  - Blind nasal intubation (if spontaneous respirations)

  Expert consultation
  - Flexible fiberoptic technique
  - Surgical airway

  Succeed
  Fail
Analgesia, Sedation, Amnesia, Neuromuscular Blockade

- Analgesia – topical, nerve blocks, sedation
- Sedation / amnesia – rapid acting, short duration, reversible

  - *Fentanyl*: 25-100 $\mu$g iv, titrated to effect
  - *Midazolam*: 1 mg iv, titrated to effect
  - *Etomidate*: 0.3-0.4 mg/kg iv, titrated to effect
  - *Lidocaine*: 1-1.5 mg/kg iv
Neuromuscular Blocking Agents

- Depolarizing agents
  succinylcholine

- Non-depolarizing agents
  long acting
  intermediate acting
  short acting
Analgesia, Sedation, Amnesia, Neuromuscular Blockade

Assess need for neuromuscular blockers

- Succinylcholine: 1–1.5 mg/kg iv bolus
- Vecuronium: 0.1–0.3 mg/kg iv bolus
- Rocuronium: 0.6–1.0 mg/kg iv bolus
- Cisatracurium: 0.1–0.2 mg/kg iv bolus
**Neuromuscular Blocking Agents**

**Succinylcholine** - cardiac arrhythmia, prolong paralysis, increase $K^+$ (cardiac arrest).

**Pancuronium** - slow onset 3-5 min, long duration 60-90 min, vagolytic effect, excreted unchanged in the urine.

**Vecuronium** - hemodynamically stable, most commonly used in ICU, duration of action 12 to 30 minutes. Cleared through bile, excreted through kidney. 3-desacetylvec - 50% potency

**Rocuronium** - no advantage over Vecuronium, ? Fast onset.

**Cisatracurium** - no hypotension/seizure, cleared via Hoffman elimination not ester hydrolysis. Very expensive.

**Mivacurium** - eliminate via plasma cholinesterase, not commonly used due to shorter-acting duration.
Orotracheal Intubation

A

B

Straight Blade Placement
Grade I  Grade II  Grade III  Grade IV
TIME TO HEMOGLOBIN DESATURATION WITH INITIAL $F_{A}O_2 = 0.87$

- Normal 70 kg Adult
- Moderately III 70 kg Adult
- Normal 127 kg Adult
- Obese 127 kg Adult

SaO$_2$, % vs. Time of $V_E = 0$, minutes
Early Complications

- Hemodynamic alterations
  - Hypertension
  - Tachycardia
  - Hypotension
- Histamine release, Vagolytic effect
- Consider effects of sedative and analgesic agents
Risk Factors for Aspiration of Gastric Contents

- Esophageal disease
- Full stomach
- Gastroparesis
- Small bowel obstruction
- Intra-abdominal pathology
- Motility disorders
- Obesity
- Pregnancy
- Trauma
- Uncertain of food or drink intake
Complications of Intubation

- Dental injury
- Cervical spine injury
- Corneal abrasion
- Vocal cord paralysis
- Epistaxis
- Aspiration
- Pharyngeal / laryngeal injuries
- Tracheal trauma
- Barotrauma
- Macroglossia
Laryngeal Mask Airways
LMA Fastrach

- Sizes: 3, 4, 5
- Latex free
- Successful ventilation in 95%
- Successful intubation
  - 1st attempt 80%
  - 2nd attempt 12%
  - 3rd attempt 4%
LMA ProSeal™

Released @ ASA 2000
Sizes 2, 3, 4, 5
Unique mask & tube design
Improved laryngeal seal
Separates respiratory & alimentary tracts
Esophageal Tracheal Combitube™
Esophageal Tracheal Combitube™
### Esophageal Tracheal Combitube

<table>
<thead>
<tr>
<th><strong>Pro’s</strong></th>
<th><strong>Con’s</strong></th>
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<tr>
<td>Easy to gain competency</td>
<td>Supraglottic device</td>
</tr>
<tr>
<td>Protects against aspiration</td>
<td>Not a definitive airway</td>
</tr>
<tr>
<td>Able to positive pressure ventilate</td>
<td>Must release cricoid pressure to place</td>
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<tr>
<td></td>
<td>Reports of esophageal tears</td>
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Trachlight™

- Skill dependent
- Blind technique
- Doesn’t work well in patients with thick necks
- No data
McGrath Scope

- Color video display rotates and tilts for better viewing
- On/Off Switch
- Non-slip rubberized handle contains a single AA battery
- Single use blade tips eliminate the need for cleaning and sterilization between cases
- Adjustable blade for different size patients
- Camera and light source
Retrograde Wire

Blind technique
Takes time
No data
Cricothyroidotomy

Fast
Definitive airway for up to 3 days
Possible complications:
  - Pneumothorax
  - Pneumomediastinum
  - Bleeding
  - Subcutaneous emphysema
Cricothyrotomy
Cricothyrotomy
Cricothyroidotomy
Cricothyroidotomy

**Pro’s**
- Fast
- Definitive airway for up to 3 days

**Con’s**
- Possible complications:
  - Pneumothorax
  - Pneumomediastinum
  - Bleeding
  - Subcutaneous emphysema
Transtracheal Jet Ventilation

- Fast
- Not a definitive airway
- No protection against aspiration
- Possible complications:
  - Pneumothorax
  - Pneumomediastinum
  - Bleeding
  - Subcut emphysema
  - Barotrauma
Fiberoptic Bronchoscopes
Clinical Considerations

Traumatic brain injury
Massive facial injury
Neck injury (blunt & penetrating)
Penetrating lung injuries
Penetrating cardiac injury
Burn patients
Shock hypotension
Geriatric patients
Patient's with GCS of < 9 are having increased ICP and being more susceptible to changes in oxygenation or ventilation.

Loss of:

- normal airway reflexes
- ability to maintain patent airway
- cerebral sensitivity to hypoxia (worse outcomes)
- cerebral vasoconstriction (low PaCO2)
- cerebral vasodilation (high PaCO2)
Traumatic brain injury

Tracheal intubation and definitive Airway control indicated for most of these patients.

RSI should avoid hypotension and involve agents designed with a neuroprotective effect in mind.
Massive Facial Injury

Progressive *edema* leading to airway obstruction, oropharyngeal bleeding leading to massive bronchial aspiration of blood and secretions, a need for an operative intervention.
Tracheal intubation, oral route preferred if possible, emergent *cricothyroidotomy* necessary in many patients with more severe injuries all by elective conversion to formal *tracheostomy*. 
Neck Injury (Blunt & Penetrating)

- Neck bleeding, endotracheal / endobronchial bleeding, direct laryngeal trauma $\Rightarrow$ Secondary airway obstruction $\Rightarrow$ inspiratory stridor $\Rightarrow$ respiratory embarrassment

- Oral tracheal intubation preferred.
Neck Injury
(Blunt & Penetrating)
Penetrating Lung Injuries

*Respiratory distress* may be caused by PTX/tension PTX, massive endobronchial bleeding, or hypovolemia. PTX/tension PTX is managed by tube thoracostomy (not tracheal intubation which may exacerbate both of these conditions).

*Massive endobronchial hemorrhage* may be an indication for intubation both for oxygenation and to enable control of endobronchial hemorrhage.
Penetrating Lung Injuries

Intubation most often based on a need for emergent operative intervention (thoracotomies) in these patients. A small risk of *air embolism* may be associated with positive pressure ventilation in patients with more central penetrating lung injuries.
Penetrating Cardiac Injury

Increased pericardial pressure $\Rightarrow$ decreased EDV $\Rightarrow$ hypotension $\Rightarrow$ respiratory embarrassment

A very high risk from institution of positive pressure ventilation and subsequent diminution in pre-load precipitating further hypotension or even cardiac arrest.
Penetrating Cardiac Injury

If possible, RSI/intubation should be deferred to the operating room after the patient is prepped, draped, and the surgical team ready to perform immediate pericardial decompression.

The ED will often require resuscitative thoracotomy in emergent decompression. This requires intubation and volume augmentation, rapid transport to OR.
**Burns**

*Airway edema* caused by direct burn injury to the face and neck, massive volume resuscitation, or inhalational injury.

Suspected major inhalational injury, burns > 20% body surface area, those requiring early operative debridement, in patients with more focused, but severe neck and facial burns should undergo *early tracheal intubation*. 
Shock Hypotension

Hypovolemia $\Rightarrow$ Dead space ratio increases $\Rightarrow$ increasing minute volume requirements

Lactic acidosis $\Rightarrow$ compensatory hyperventilation

Severe shock profusional deficiencies $\Rightarrow$ diaphragm
$\Rightarrow$ decreases ventilatory capacity $\Rightarrow$ intubation

The risk of exacerbating hypotension associated with \textit{positive pressure ventilation} is frequently noticeable.
Shock Hypotension

Hypovolemic/shock is not an automatic indication for tracheal intubation. Intubation should be based on the specific injury type producing the hypovolemia, observed patient response to fluid resuscitation, and expectations for immediate correction and need for definitive care (i.e. angiography, operating room).

Tracheal intubation should proceed in accordance with volume resuscitation.
Geriatric Patients

Elderly patients have decreased ventilatory capacity less cardiac vascular reserve and may present with precipitous hypotension, and more fragile chest walls. **Prophylactic intubation** should be strongly considered in patients that will require any operative intervention, or those requiring angioembolization for pelvic fractures.
Patients with pulmonary contusions demonstrable on initial chest x-ray with any degree of respiratory embarrassment or deficiencies in gas exchange should usually undergo tracheal intubation.
Judgment comes from experience.

Experience comes from bad judgment.
Objectives

1. Technical Considerations
2. Therapeutic Goal of Airway Management
3. Clinical and Physiological Considerations
Troubleshooting

Inability to place oral or nasal endotracheal tube
Inability to ventilate
Hypoxeia (inability to provide adequate oxygenation)
Cardiac arrest - PEA
Hypotension
Hyper- and hypoventilation
No ETCO$_2$ tracing
Bradycardia